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NOTES ON GEOGRAPHIC DISTRIBUTION

Physalaemus maximus Feio, Pombal Jr. and Caramaschi, 1999 (Anura: Leiuperidae): Distribution extension and advertisement call

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ABSTRACT: This study provides the first record of *Physalaemus maximus* in the state of Espírito Santo, southeastern Brazil. *Physalaemus maximus* was recorded in the Municipality of Castelo (1100 m a.s.l.), where it was observed in explosive reproduction in an Atlantic Forest remnant on 06 January 2010. The advertisement call of *P. maximus* consisted of a single multipulsed note, with carrier frequency emitted in 1,250 Hz and mean duration of 2.10 s. The record from Castelo extends in approximately 140 km eastward from the previous geographic distribution admitted for the species.

The genus *Physalaemus* Fitzinger, 1826, contains 45 recognized species distributed from northern to southern South America (Nascimento *et al*. 2005; Weber *et al*. 2005; Cruz *et al*. 2008; Cassini *et al.* 2010; Frost 2010). Nascimento *et al*. (2005) revised the systematic of the genus *Physalaemus* and defined seven species group, considering *Physalaemus aguirrei* Bokermann, 1966, *Physalaemus maximus* Feio, Pombal Jr. and Caramaschi, 1999, *Physalaemus olfersii* (Lichtenstein and Martens, 1856), and *Physalaemus soaresi* Izecksohn, 1965 as a monophyletic group, denominate *P. olfersii* species group. Recently, Cassini *et al*. (2010) described three new species (*P. lateristriga*, *P. feioi* and *P. orophilus*) belonging to the *P. olfersii* group (*sensu* Nascimento *et al*. 2005). This assemblage occur in the Atlantic Rain Forest Domain (*sensu* Ab`Sáber 1977), from the state of Bahia southwards to the state of Santa Catarina, Brazil (Baêta *et al*. 2007; Cruz *et al*. 2008; Cassini *et al.* 2010).

Physalaemus maximus is known from its type locality, Neblina farm (20°42' S and 42°29' W, 1,375 m above sea level), Serra do Brigadeiro, Municipality of Araponga; from Santa Rita de Ouro Preto (20°29' S and 43°35' W, 1248 m a.s.l.), Municipality of Ouro Preto; and from Serra do Ouro Branco, Municipality of Ouro Branco (20°38' S and 43°45' W, 1150 m a.s.l.), in the state of Minas Gerais, Brazil (Feio *et al.* 1999; Baêta *et al*. 2005; 2007; Santana and Moura 2011). Herein, we provide the first record of *P. maximus* in the state of Espírito Santo, southeastern Brazil. Data on the advertisement call of the collected individuals are also presented in this study.

We observed *Physalaemus maximus* in explosive reproduction on 06 January 2010 in the mountainous region of state of Espírito Santo (Serra da Mantiqueira). Two adult males of *P. maximus* (Figure 1) were collected on the Forno Grande farm (20°30'31" S and 41°03'17" W, 1100 m a.s.l.), Municipality of Castelo (Figure 2). They were found under dead leaves on the edge of a small stream (about 1.0 m wide and 0.2 m deep) near the border of an Atlantic Forest remnant (about 400 ha). These two males and other not collected individuals were surveyed at around 20:00 h, and were calling during fine rain (air temperature = 16.8°C; air relative humidity = 96%). The specimens collected were deposited in the Museu de Biologia Prof. Mello Leitão (MBML 7232, ♂, Snout Vent Length (SVL) = 39 mm; MBML 7233, ♂, SVL= 45 mm), Municipality of Santa Teresa, state of Espírito Santo, Brazil. The research authorization was granted by the IBAMA/NUFAUNA, process Nº 02009.001088/2009.

FIGURE 1. Adult male of *Physalaemus maximus* (MBML 7232) from the Municipality of Castelo, state of Espírito Santo, Brazil.

We also recorded the advertisement call of *Physalaemus maximus* using a Sony TCM 5000 EV cassette recorder with a Sennheiser ME-66 microphone. The samples of the vocalizations were digitized with the software Avisoft SasLab Light, version 1.0, with sampling frequency of 16 kHz and 16 bits resolution. The sonograms were elaborate with the software Sound Ruler Acoustic Analysis, version 9.6, with FFT-length= 256 points, Overlap between FFTs= 0.9 and Window type= Hanning. Sound recordings were

deposited in the Arquivo Sonoro Prof. Elias P. Coelho (ASEC), Departamento de Zoologia, Instituto de Biologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil.

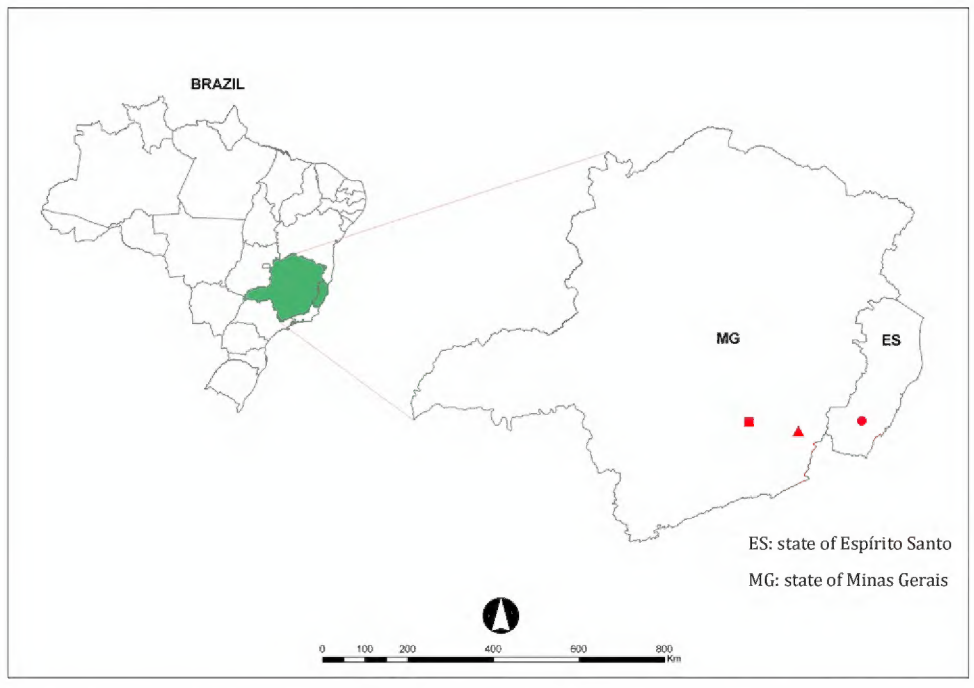

FIGURE 2. Known records of *Physalaemus maximus*: triangle (type locality), Neblina farm, Serra do Brigadeiro, municipality of Araponga, state of Minas Gerais; square, Santa Rita de Ouro Preto/Serra do Ouro Branco, municipality of Ouro Preto and municipality of Ouro Branco, state of Minas Gerais; dot (the new record), Forno Grande farm, municipality of Castelo, state of Espírito Santo.

The advertisement call of *Physalaemus maximus* consisted of one single multipulsed note, with mean duration of 2.10 s (SD= ± 0.19; range= 1.79 – 2.53; n= 21 calls of one male) and mean intercall interval of 2.40 s (SD= ± 0.55; range= 1.73 – 3.41; n= 15) (Figure 3a). The carrier (or dominant) frequency was emitted in 1,250 Hz (central value), without perceptible frequency modulation and with greater gain of energy 0.50 s after the beginning of its emission (Figure 3b). The call presented other six frequency components visible in the sonogram, corresponding possibly to three pairs of sidebands (*sensu* Greenewalt 1968; Vielliard 1993), emitted between 598 and 1,860 Hz. In a sample analyzed of the call, the peak of higher acoustic energy is concentrated at 1,230 Hz (Figure 3c). The following species of anurans were calling in the same call site of *Physalaemus maximus*: *Dendropsophus* cf. *minutus* (Peters, 1872), *Aplastodiscus leucopygius* (Cruz and Peixoto, 1985), *Phyllomedusa rohdei* Mertens, 1926 and *Proceratophrys boiei* (Wied-Neuwied, 1824).

The first description of the advertisement call of *Physalaemus maximus* was presented by Baêta *et al.* (2007), based on recordings from Santa Rita, Municipality of Ouro Preto, state of Minas Gerais. The advertisement call recorded by us in Castelo agrees with the description of Baêta *et al*. (2007). However, the call described by them presents weak descendent frequency modulation and dominant frequency always corresponding to the first harmonic, emitted in 732 or 775 Hz (*versus* 1,250 Hz in the call from Castelo). The harmonics reported by Baêta *et al*. (*op. cit.*) seem to correspond to sidebands as verified in the call of *P. maximus* from Castelo and in the calls of other species of the *Physalaemus olfersii group (e.g.* Cassini *et al*. 2010). Acoustics parameters of the call from Castelo are similar from those obtained to the topotypic call of *P. maximus* (one single multipulsed note, frequency dominant of 1,070 Hz, mean duration of 2.05 s, non-harmonic structure and slight frequency modulation at the beginning) recently described by Santana and Moura (2011). The congruence among the descriptions of the call from Castelo, Ouro Preto, and Araponga (type locality) indicates that there is little interpopulational differentiation in the advertisement call of this species. This reinforces the diagnostic value of this character in order to recognize cryptic species in the genus *Physalaemus*, as used before by Nascimento *et al*. (2005), Weber *et al.* (2005) and Cassini *et al*. (2010).

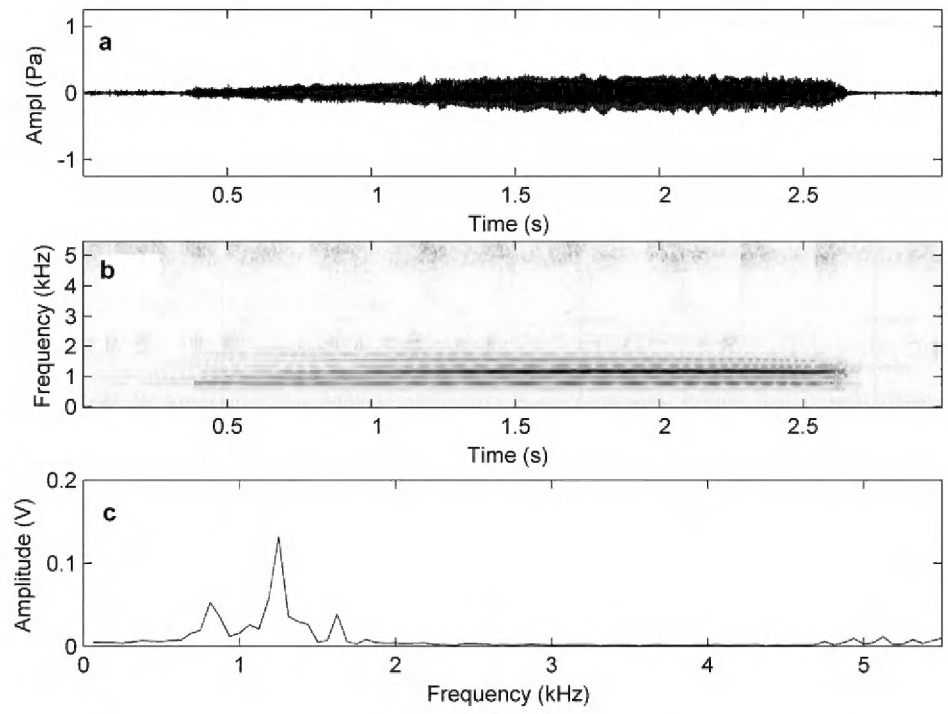

FIGURE 3. Oscillogram (a), sonogram (b) and power spectrum (c) of the advertisement call of *Physalaemus maximus* recorded in Castelo, state of Espírito Santo, southeastern Brazil, on 06 January 2010, at around 20:00 h. Air temperature = 16.8°C; air relative humidity = 96%. Voucher specimen: MBML 7232.

This study represents the third record of *Physalaemus maximus* out of its type locality, and the first record in the state of Espírito Santo, where were known eight species of *Physalaemus*: *P. aguirrei* Bokermann, 1966, *P. crombiei* Heyer and Wolf, 1989, *P. cuvieri* Fitzinger, 1826, *P. marmoratus* (Reinhardtand and Lütken, 1862), *P. maculiventris* (Lutz, 1925), *P. obtectus* Bokermann, 1966, *P. olfersii* (Lichtenstein and Martens,1856) and *P. signifer* (Girard, 185) (Almeida *et al*. 2011). This study also represents a new record for anuran amphibians of Pedra Azul-Forno Grande Biodiversity Corridor, where 43 species were surveyed by Montesinos *et al*. (2012). The occurrence of *P. maximus* in the Municipality of Castelo extends in approximately 140 km (straight-line distance) eastward from the previous geographic distribution admitted for the species. In addition, this new record reinforces that *P. maximus* is an anuran restricted to altimountainous region (> 1,000 m a.s.l.) of the southeastern Brazil (Feio *et al.* 1999; Baêta *et al.* 2005; 2007; Cruz and Feio 2007).

The localities where *Physalaemus maximus* have been recorded are native forest remnants surrounded by anthropogenic areas (see Montesinos *et al*. 2012), and only the Fazenda Neblina (type-locality) is formally protected (Parque Estadual Serra do Brigadeiro, a protected area in Minas Gerais). The surroundings have been severely degraded due to introduction of grazing, coffee, tomato, strawberry, and *Eucalyptus* plantations, aggradation in water bodies, pesticides, land subdivision, burning, deforestation, etc (JES, personal obs.). The new Brazilian Forest Act (Law Project Nº 1876/99) has been discussed

by the Brazilian government. If adopted, it will enhance degradation of native forests, causing serious impacts on amphibian populations due to habitat loss, endogamy, disease incidence, mortality of eggs and larvae, etc (Toledo *et al*. 2010). In addition, the great number of species associated with small streams (permanent or temporary) will be particularly affected, because this law project reduces the legal areas permanently preserved around streams (Toledo *et al*. 2010). *Physalaemus maximus* is not recognized as a threatened anuran (IUCN 2011). However, its habitats (pond/stream margins and isolated tops of mountains) are very vunerable and populations are under evident risk, specially in areas under strong human use. Thus, endemic anurans from highland areas of southeastern Brazil (*e.g.,* Cruz and Feio 2007; Siqueira *et al*. 2011) should be focal species for researches and conservation actions in Atlantic Rain Forest.

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